What is claimed is:

1. A MODU jacking system for providing relative motion between a MODU platform and a MODU supporting leg having at least one leg chord with at least one toothed rack, comprising

a plurality of piston/cylinder units for said at least one toothed rack, each of the plurality of piston/cylinder units having an extendable and retractable piston and a toothed rack engagement member driven by its piston;

a plurality of engagement/disengagement means for engaging and disengaging the toothed rack engagement members of the plurality of piston/cylinder units with the toothed rack; and

a source of hydraulic pressure for driving the pistons of the plurality of piston/cylinder units,

said MODU jacking system providing a continuous relative motion between the MODU platform and the MODU supporting leg during jacking operations by operating a portion of the engagement/disengagement means and engaging a portion of the plurality of the toothed rack engagement members of a portion of the plurality of piston/cylinder units with the toothed rack, and operating said engaged portion of the plurality of piston/cylinder units to provide said continuous relative motion while operating one engagement/disengagement means and disengaging the toothed rack engagement member of one of the plurality of piston/cylinder units and operating the disengaged one of the plurality of piston/cylinder units to reposition the disengaged toothed rack engagement member for re-engagement with the toothed rack and providing said continuous relative motion.

2. The MODU jacking system of claim 1, wherein said plurality of piston/cylinder units for said at least one toothed rack comprises at least three piston/cylinder units, and the engaged operating times of each of the three piston/cylinder units are offset from the engaged operating times of the other two piston/cylinder units so that two piston/cylinder units are driving engaged toothed rack engagement means, while the third piston is retracting to position its toothed rack engagement means for re-engagement with the toothed rack.

3. The MODU jacking system of claim 1, wherein said plurality of piston/cylinder units for said at least one toothed rack comprises N units, and wherein operation of the pistons of said N units is phased so that N-1 units are engaged with and providing relative motion at all times during jacking operations while one of said N units is disengaged from the toothed rack and is being retracted.

4. The MODU jacking system of claim 1, wherein the engagement/disengagement means comprise compression springs acting to urge the toothed rack engagement members generally horizontally into engagement with the toothed racks, and unclamping piston/cylinder units operable by hydraulic pressure to pull and disengage the toothed rack engagement members from the toothed rack.

5. The MODU jacking system of claim 1, wherein the piston/cylinder units of said plurality of piston/cylinder units are pivotally attached to and carried by the MODU platform so their central axes are pivoted through a small angle for engagement and disengagement of their toothed rack engagement members.

6. The MODU jacking system of claim 5 wherein the at least one toothed rack comprises a plurality of teeth with planar engagement surfaces, and the toothed rack engagement members each comprise a plurality of teeth with mating planar engagement surfaces, the angles of the planar engagement surfaces of the mating teeth of the toothed rack and toothed rack engagement members being normal to the central axes of the plurality of piston/cylinder units at mid-stroke of the pistons' extension.

7. The MODU jacking system of claim 5, wherein at least one of the pivotal attachments of the plurality of piston/cylinder units includes a load sensor with an output providing an operator signal.

8. The MODU jacking system of claim 8 wherein said operator signal provides a warning in the event of an unacceptable load sensed by the load sensor.

9. The MODU jacking system of claim 1 wherein said of teeth of the toothed rack and toothed rack engagement members have a tooth pitch T; the number of cylinders in the plurality of piston/cylinder units is N; the vertical travel of the toothed rack engagement members is T x N, and the vertical distance between the pivotal attachments of each of the N piston/cylinder units is T(N-1).

10. The MODU jacking system of claim 1 wherein the MODU platform and MODU supporting leg are locked in a stationary position by ceasing said continuous relative motion, disengaging a portion of the engaged toothed rack engagement members of said engaged portion of the plurality of piston/cylinder units from the toothed rack, and operating their piston/cylinder units to retract their pistons substantially entirely within their cylinders,

and re-engaging the retracted toothed rack engagement members of said disengaged portion of the piston/cylinder units while maintaining engagement of the remainder of the toothed rack engagement members with the toothed rack, and repeating the operation with different portions of the toothed rack engagement members of the plurality of piston/cylinder units until all pistons of the plurality of piston/cylinder units are substantially entirely within their cylinders with all toothed rack engagement members engaged with the toothed racks.

11. The MODU jacking system of claim 10 wherein said engagement/disengagement means for each toothed rack engagement member comprises a compression spring urging each toothed rack engagement member into engagement with the toothed rack, and wherein no power is expended in maintaining the MODU locked in said stationary position.

12. The MODU jacking system of claim 10, wherein said piston/cylinder units of said plurality of piston/cylinder units are pivotally attached at their cylinder ends to the MODU platform, said engagement/disengagement means pivoting said piston/cylinder units during their operation; said at least one toothed rack has a plurality of teeth with angled planar engagement surfaces, and said toothed rack engagement members have a plurality of teeth with mating angled planar engagement surfaces; said plurality of angled planar engagement surfaces of said toothed racks and said toothed rack engagement members generating in their engagement, forces resisting the disengagement of the toothed rack engagement members, with the pistons in their retracted positions.

13. The MODU jacking system of Claim 10 wherein said engagement/disengagement means of each toothed rack engagement member comprises a hydraulic piston/cylinder attached to disengage the toothed rack engagement member from the toothed rack, and a compression spring acting on the toothed rack engagement member to urge the toothed rack engagement member into engagement with the toothed rack.

14. The MODU jacking system of claim 5 wherein the toothed rack engagement members and the toothed rack have pluralities of teeth with mating angled planar engagement surfaces, and the mating angled planar engagement surfaces of the plurality of teeth, with the pistons at mid-extension, are normal to the central axes of the piston/cylinder units, and said mating angled planar engagement teeth surfaces, when engaged, apply pressure substantially uniformly across the angled planar engagement surfaces of the plurality of engaged teeth.

15. The MODU jacking system of claim 14, wherein said plurality of engaged angled planar engagement surfaces of said toothed rack engagement members and said toothed rack generate, in their engagement, forces resisting disengagement of the toothed rack engagement members from the toothed racks with the pistons of the plurality of piston/cylinder units in their retracted positions.

16. The MODU jacking system of claim 14 wherein said plurality of engaged angled planar engagement surfaces of said toothed rack engagement members and said toothed racks generate, in their engagement, forces assisting disengagement of the toothed rack engagement members from the toothed rack with the pistons of the plurality of piston/cylinder units fully extended.

17. The MODU jacking system of claim 1 wherein said relative motion is effected by a control carried by the MODU, operating said plurality of piston/cylinder units and said plurality of engagement/disengagement members to provide a MODU jack up cycle, a MODU jack down cycle, and a MODU position locking cycle.

18. The MODU jacking system of claim 17 wherein, upon receiving an operator input to move from the MODU position locking mode to either of the MODU jack up and MODU jack down modes, said control automatically operates a sequential disengagement and positioning of portions of the toothed rack engagement members for phased operation to provide said relative motion.

19. The MODU jacking system of claim 17 wherein at least one of the plurality of piston/cylinder units is carried by the MODU platform with a load sensor, whose output is monitored by the control and provides indicia of the load conditions and a warning of unacceptable load conditions.

20. The MODU jacking system of claim 1 wherein said at least one leg chord comprises a tubular column with said at least one toothed rack welded on the side of the tubular column.

21. A method of jacking a MODU platform without interruption, comprising:

providing a plurality of MODU supporting legs;

providing a plurality of toothed racks fastened to said plurality of MODU supporting legs;

providing a plurality of hydraulic piston/cylinder units attached to said MODU platform, each of said plurality of hydraulic piston/cylinder units having a toothed rack engagement member attached to and driven in a vertical direction by its piston and engageable with one of said toothed racks;

engaging a portion of the plurality of said toothed rack engagement members of a portion of said plurality of piston/cylinder units with said toothed racks; and

driving said engaged portion of the plurality of toothed rack engagement members by applying hydraulic pressure to said portion of the plurality of piston/cylinder units to extend their pistons and thereby continuously provide relative motion between the MODU platform and MODU supporting legs while a remainder of the toothed rack engagement members are disengaged from said toothed racks and are being repositioned for engagement with the toothed racks by applying hydraulic pressure to retract their pistons.

22. In the manufacture of a MODU jacking system capable of withstanding at least a maximum leg load of W, the improvement comprising:

manufacturing a plurality of MODU supporting legs capable of carrying a plurality of toothed racks;

selecting a number of toothed racks R and fastening the toothed racks on the plurality of MODU supporting legs;

selecting a number of hydraulic piston/cylinders N, having a commercially available diameter d;

manufacturing a plurality of rack engagement member capable of engagement with one of the toothed racks and attaching a rack engagement member to each piston of each hydraulic piston/cylinder;

providing a source of hydraulic pressure P on the MODU to provide relative motion between the MODU platform and the MODU supporting legs by application of hydraulic pressure to the hydraulic piston/cylinders; and

fastening said plurality of hydraulic piston/cylinder units to said MODU in a manner permitting engagement of their rack engagement members with the toothed racks,

said selection of the number R of toothed racks, the number N of hydraulic piston/cylinders per rack, and the diameter d of the pistons being defined by

$$\frac{\pi P\, R d^2 (N-1)}{4} \geq W$$

23. In a MODU jacking system comprising a MODU platform, a plurality of MODU supporting legs, and means for providing relative motion between the MODU

platform and the plurality of MODU supporting legs, the improvement wherein said means for providing relative motion between the MODU platform and plurality of MODU supporting legs comprises a plurality of continuous linear motion motors, with at least one such motor for each of the plurality of MODU supporting legs, each of said plurality of continuous linear motion motors comprising N hydraulic piston/cylinder units, and wherein operation of the pistons of said N hydraulic piston/cylinder units is phased during jacking so that N-1 units are engaged with the MODU supporting legs and providing said relative motion at all times while one of said N units is disengaged from the toothed rack and is being repositioned for re-engagement with the toothed rack to provide said relative motion.

24. In the improved MODU jacking system of claim 23, the further improvement wherein the continuous relative motion between the MODU platform and the MODU supporting legs is provided by engaging of a portion of the N hydraulic piston/cylinder units and operating their pistons for a long driving cycle while said one of said piston/cylinder units is disengaged from the MODU supporting leg and being repositioned during a repositioning cycle substantially shorter than the drive cycle.

25. In a MODU jacking system comprising a MODU platform, a plurality of MODU supporting legs and means for providing relative motion between the MODU platform and the plurality of MODU supporting legs, the improvement wherein said means for providing relative motion between the MODU platform and the plurality of MODU supporting means comprises a plurality of piston/cylinder units for each MODU supporting leg, each of said plurality of piston/cylinder units having a toothed rack engagement member attached to its piston and each of the MODU supporting legs having a toothed rack, wherein relative motion is provided between the MODU platform and MODU supporting legs by phased engagement of toothed rack engagement members with the toothed racks and phased operation of the pistons of the piston/cylinder units of the engaged toothed rack engagement members, and wherein the MODU platform and MODU supporting legs can be locked together in a stationary position by engagement of all of the toothed rack engagement members of all of the piston/cylinder units with the toothed racks.

26. In the improved MODU jacking system of claim 25, the further improvement wherein the MODU platform and MODU supporting legs are locked in a selected stationary position by ceasing phased operation of the pistons of the plurality of piston/cylinder units, disengaging the toothed rack engagement members of a portion of the plurality of piston/cylinder units from the toothed racks, retracting the pistons of the disengaged toothed

rack engagement members substantially entirely within the cylinders of the piston/cylinder units, and re-engaging the retracted toothed rack engagement members of said portion of the piston/cylinder units while maintaining engagement of the remainder of the toothed rack engagement members with the toothed racks, and repeating the operation with different portions of the plurality of piston/cylinder units until all pistons of the piston/cylinder units are substantially entirely within their cylinders with all toothed rack engagement members engaged with the toothed racks.

27. In the improved MODU jacking system of claim 25 the further improvement comprising a plurality of means for engagement and disengagement of the toothed rack engagement members from the toothed racks, the means for engagement and disengagement of each toothed rack engagement member including a compression spring urging each toothed rack engagement member into engagement with a toothed rack, wherein no power is expended in locking the MODU platform and MODU supporting legs in said stationary position.

28. In the improved MODU jacking system of claim 25, the further improvement wherein said plurality of piston/cylinder units are pivotally attached at their cylinder ends to the MODU platform, said piston/cylinder units being pivoted to effect the engagement and disengagement of the toothed rack engagement members during the operation, and wherein said toothed racks have a plurality of teeth with angled planar engagement surfaces, and said toothed rack engagement members have a plurality of teeth with mating angled planar engagement surfaces, said plurality of angled planar engagement surfaces of said toothed rack engagement members and said toothed racks generating in their engagement, forces resisting the disengagement of the toothed shoes, with the pistons in their retracted positions.

29. The improved MODU jacking system of claim 27 wherein said means for engagement and disengagement for each toothed rack engagement member comprises a hydraulic piston/cylinder attached to toothed rack engagement members to overcome the urging of the compression spring and disengage the toothed rack engagement member from the toothed rack.

30. In a MODU jacking system comprising a MODU platform, a plurality of MODU supporting legs, and means including a plurality of driving toothed members and a plurality of driven toothed members on the plurality of MODU supporting legs, for providing relative motion between the MODU platform and the plurality of MODU supporting legs, the

improvement wherein the plurality of driving toothed members comprise continuous linear motion motors driving pluralities of teeth having planar engagement surfaces, and said plurality of driven toothed members comprise racks with pluralities of teeth having planar engagement surfaces, the planar engagement surfaces of said continuous linear motion motor, and said rack mating so the stresses resulting from the driving force of said plurality of teeth of said continuous liner motion motor are substantially uniformly distributed on the planar engagement surfaces of the engaged teeth.

31. In a MODU jacking system comprising a MODU platform, a plurality of MODU supporting legs and means for providing relative motion between the MODU platform and the plurality of MODU supporting legs, the improvement wherein each of said plurality of MODU supporting legs includes a plurality of leg chords, each leg chord comprising a tubular column with a toothed rack welded on opposite sides of the tubular column, and wherein the means for providing relative motion between the MODU and the plurality of supporting legs comprises at least one continuous linear motion motor engaged with the toothed racks of each of the leg chords of each of the MODU supporting legs.

32. In a MODU jacking system comprising a MODU platform, a MODU supporting leg, and means including at least one driving toothed member and at least one driven toothed member on the MODU supporting leg, for providing relative motion between the MODU platform and the plurality of MODU supporting leg, the improvement wherein the driving toothed member and the driven toothed member comprise teeth having mating planar upper and lower engagement surfaces driven by a continuous linear motion motor.

33. The improved MODU jacking system of claim 32, wherein the planar upper and lower engagement surfaces are angled.

34. The improved MODU jacking system of claim 33 wherein the angled upper planar engagement surfaces are angled at an angle $\alpha 1$ and the angled lower planar engagement surfaces are angled at an angle $\alpha 2$, and the angles $\alpha 1$ and $\alpha 2$ are equal.

35. The improved MODU jacking system of claim 33 wherein the angled upper planar engagement surfaces are angled at an angle $\alpha 1$ and the angled lower planar engagement surfaces are angled at an angle $\alpha 2$, and angle $\alpha 2$ is greater than angle $\alpha 1$.

36. The improved MODU jacking system of claim 32 wherein the driving toothed member comprises a plurality of teeth mating with a plurality of teeth of the driven toothed member.

37. The improved MODU jacking system of claim 32 wherein the continuous linear motion motor provides a jack-up mode, a jack-down mode, and a MODU locking mode.